

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43bis.1)

Date of mailing

(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.
PCT/US2004/040460

International filing date (day/month/year)
02.12.2004

Priority date (day/month/year)
02.12.2003

International Patent Classification (IPC) or both national classification and IPC
H01L35/30, H01L35/08

DOCKETED FOR: 6/7/04

Applicant
BATTELLE MEMORIAL INSTITUTE

COMPUTER

BOOK

SCAN

CC:

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☒ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

10/581281

International application No.
PCT/US2004/040460

IAP20 Rec'd PCT/PTO 31 MAY 2006

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
 - ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material:
 - ☐ a sequence listing
 - ☐ table(s) related to the sequence listing
 - b. format of material:
 - ☐ in written format
 - ☐ in computer readable form
 - c. time of filing/furnishing:
 - ☐ contained in the international application as filed.
 - ☐ filed together with the international application in computer readable form.
 - ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/US2004/040460

Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees, the applicant has:
- ☒ paid additional fees.
 - ☐ paid additional fees under protest.
 - ☐ not paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
- ☐ complied with
 - ☒ not complied with for the following reasons:
see separate sheet
4. Consequently, this report has been established in respect of the following parts of the international application:
- ☒ all parts.
 - ☐ the parts relating to claims Nos.

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	2,3,7-12, 16, 19-22, 28, 29, 31, 34-36,67-85
	No: Claims	1, 4-6, 13-15, 17-18, 23,27,30,32,33,37-66
Inventive step (IS)	Yes: Claims	
	No: Claims	1-85
Industrial applicability (IA)	Yes: Claims	1-85
	No: Claims	

2. Citations and explanations

see separate sheet

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/US2004/040460

Box No. VI Certain documents cited

1. Certain published documents (Rules 43*bis*.1 and 70.10)

and /or

2. Non-written disclosures (Rules 43*bis*.1 and 70.9)

see form 210

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING
AUTHORITY (SEPARATE SHEET)**

10/581281
International application No.

PCT/US2004/040460

AP20 Rec'd PCT/PTO 31 MAY 2006

Reference is made to the following documents:

- D1: DE 297 23 309 U1 (D.T.S. GESELLSCHAFT ZUR FERTIGUNG VON
DUENNSCHICHT-THERMOGENERATOR-SY) 10 September 1998 (1998-09-10)
D2: WO 2004/105143 (APPLIED DIGITAL SOLUTIONS) 2 December 2004 (02.12.04)
D3: PATENT ABSTRACTS OF JAPAN vol. 1997, no. 08, 29 August 1997 (1997-08-29) &
JP 09 107129 A (SHARP CORP), 22 April 1997 (1997-04-22)
D4: SCHMIDT F: "Batterielose Funksensoren, betrieben mit Energie aus der Umgebung"
11 March 2002 (2002-03-11), XP002231431 Retrieved from the Internet:
URL: http://www.enocean.com/comments/tagung_0302.pdf [retrieved on 2006-02-28]
D5: PATENT ABSTRACTS OF JAPAN vol. 1997, no. 12, 25 December 1997 (1997-12-
25) - & JP 09 224387 A (WAKABAYASHI TADATOSHI), 26 August 1997 (1997-08-26)
D6: US-A-3 554 815 (ROBERT OTTO OSBORN) 12 January 1971 (1971-01-12)
D7: WO 02/23642 A (FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER
ANGEWANDTEN FORSCHUNG E.V.) 21 March 2002 (2002-03-21)
D8: PATENT ABSTRACTS OF JAPAN vol. 2003, no. 10, 8 October 2003 (2003-10-08) -
& JP 2003 179275 A (YASKAWA ELECTRIC CORP), 27 June 2003 (2003-06-27)

Re Item IV

Lack of unity of invention

This Authority considers that there are three inventions covered by the claims indicated as follows:

1. Claims 1-36

A thermoelectric power source comprising a flexible substrate and a sputtered thin film of thermoelectric material and method of making it.

2. Claims 37-66

A method and apparatus for providing electrical energy by transmitting ambient energy to a thermoelectric device

3. Claims 67-85

A thermoelectric power source comprising a sputtered film of thermoelectric material and a high temperature heat pipe and a low temperature heat pipe; and/or a thermoelectric

power source comprising a thin film TE module formed on a flexible substrate and a reel about which the flexible substrate is wound.

The reasons for which the inventions are not so linked as to form a single general inventive concept, as required by Rule 13.1 PCT, are as follows:

Rule 13.1 PCT requires that the international application shall relate to one invention only or to a group of inventions so linked as to form a single general inventive concept ("requirement of unity of invention"). According to Rule 13.2 PCT, where a group of inventions is claimed in one and the same international application, the requirement of unity of invention referred to in Rule 13.1 shall be fulfilled only when there is a technical relationship among those inventions involving one or more of the same or corresponding special technical features. The expression "special technical features" shall mean those technical features that define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art.

The prior art has been identified as document DE 297 23 309 U which discloses a thermoelectric power source comprising a flexible substrate and a thermoelectric couple comprising sputter deposited thin films. Therefore claim 1 contains no technical feature which makes a contribution over the prior art and can be considered as a special technical feature within the meaning of Rule 13.2 PCT. Therefore the first invention (claims 1-36) cannot be linked to any other invention by special technical features.

Claims 37-66 relate to a method and apparatus for providing electrical energy by transmitting ambient energy to a thermoelectric device. A priori there are no special technical features in common with the first or third named invention.

Furthermore claims 67-85 relate to a thermoelectric power source comprising a sputtered film of thermoelectric material and a high temperature heat pipe and a low temperature heat pipe; and/or a thermoelectric power source comprising a thin film TE module formed on a flexible substrate and a reel about which the flexible substrate is wound. This invention has matter in common with the first invention of "a thermoelectric power source comprising a sputtered film of thermoelectric material". However, as this matter is not new in view of the document named above, there are no common special technical features.

In conclusion, the groups of claims are not linked by common or corresponding special technical features and define three different inventions not linked by a single general inventive concept.

The application, hence does not meet the requirements of unity of invention as defined in Rules 13.1 and 13.2 PCT.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Invention 1, Claims 1-36

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 1, 4-6, 13-15, 17-18, 23, 27, 30, 32,33 is not new in the sense of Article 33(2) PCT and because the subject-matter of claims 2,3,7-12, 16, 19-22, 28, 29, 31, 34-36 does not involve an inventive step in the sense of Article 33(3) PCT.

1.1 INDEPENDENT CLAIM 1

The document D1 discloses (the references in parentheses applying to this document, cf. Figs 2-5 and page 4, pgh 2 to 5):

a thermoelectric power source comprising:

a flexible substrate (polyimide film 1) having an upper surface; and

a thermoelectric couple (4) comprising:

(a) a sputter deposited thin film p-type thermoelement (4') positioned on the upper surface of the flexible substrate;

(b) a sputter deposited thin film n-type thermoelement (4'') positioned on the upper surface of the flexible substrate adjacent the p-type thermoelement; and

(c) an electrically conductive member (Metallbrücke 4''') positioned on the flexible substrate and electrically connecting a first end of the p-type thermo element with a second end of the n-type thermoelement.

1.2 The additional features of claims 4-6, 13-15 and 17-18 are also known from D1, see passages cited above.

The additional features of claims 2, 3 when interpreted from the description as length of leg of the thermoelement divided by the cross sectional area are obvious to a skilled person in view of the Figures. Since the thermoelements of D1 are made of a thin film material, the cross sectional area will be significantly smaller than the length. This is considered as falling within the limits given in these claims.

Likewise the specific lengths and thicknesses given in claims 7 and 8 are considered as falling within the range expected by a skilled person reading D1.

The additional features of claim 9 regarding the power output would be regarded by the skilled person as achievable using the device of D1 with a sufficient number of thermocouples.

The geometric arrangement cited in claim 10 is known from document D2, which is a prior filed document but published on the filing date of this application.

The circuit arrangements according to claims 11 and 16 are obvious variations for a skilled person, for example to reduce overall resistance of the device.

The additional feature of claim 12 of the flexible substrate in a coil configuration is known from document D3, see abstract and is an obvious alternative to the stacked arrangement shown in D1.

The use of a superlattice thermoelement on a thin film device according to claims 19-22 is already known from document D3.

1.3 INDEPENDENT CLAIM 23

The document D1 discloses (the references in parentheses applying to this document, cf. Figs 2-5 and page 4, pgh 2 to 5):

a thermoelectric power source comprising:
a flexible substrate (polyimide film 1) having an upper surface;
multiple thermocouples (4) electrically connected to one another on the upper surface of

the flexible substrate, the thermocouples comprising:
sputter deposited thin film p-type thermoelements (4') ;
sputter deposited thin film n-type thermoelements (4'') alternatingly positioned adjacent the
p-type thermoelements; and
wherein the thermoelectric power source has a volume of less than about 10 cm³ and has
a power output of from about 1 microWatt to about 1 W (see page 4, pgh 4).

Therefore the subject matter of claim 23 is not new.

The additional features of claims 24 and 25 are obvious to a skilled person, see reasoning
above for claims 10 and 11.

1.4 INDEPENDENT CLAIM 26

The document D1 discloses (the references in parentheses applying to this document, cf.
Figs 2-5 and page 4, pgh 2 to 5):

a method for fabricating thermoelectric power sources comprising:
providing a flexible substrate (polyimide film 1);
sputter depositing multiple thin films of n-type thermoelectric material (4') onto the flexible
substrate;
sputter depositing multiple thin films of p-type thermoelectric material (4'') onto the flexible
substrate; and
forming multiple thermocouples (4) on the flexible substrate by electrically connecting
(Metallbrücke 4''') the thin films of p-type thermoelectric material to the thin films of n-type
thermoelectric materials.

Therefore the subject matter of claim 26 is not new.

The additional features of claims 27, 30, 32 and 33 are known from D1, see passage
referenced above.

The additional features of claims 28 and 29 are obvious to a skilled person in view of D1.
The additional feature of claim 31 of further comprising winding the flexible substrate into a
coil configuration is known from document D3 and is an obvious alternative to the stacked

arrangement shown in D1.

The additional features of claims 34-36 concern standard conditions for sputtering which would be selected routinely by a person skilled in the art.

2. Invention 2, Claims 37-66

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 37-49 is not new in the sense of Article 33(2) PCT.

2.1 INDEPENDENT CLAIM 37

The document D4 discloses (the references in parentheses applying to this document, cf. Bild 1, 7 and 8):

A method for providing electrical energy to an electrical device (thermally powered transmitter) in an environment having a first and a second temperature region comprising the steps of:

providing a means for transmitting ambient energy collected in the first temperature region (Umgebungsenergie),

providing a thermoelectric device having a first side and a second side (Energiewandler), providing the means for transmitting the ambient energy collected in the first temperature region in communication with the first side of the thermoelectric device (contact by conduction), and

providing the second side of the thermoelectric device in communication with the second temperature region.

2.2 Dependent claims 38-49 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, see D4.

2.3 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 50-66 is not new in the sense of Article 33(2) PCT.

INDEPENDENT CLAIM 50

The document D4 discloses (the references in parentheses applying to this document, cf. Bild 1, 7 and 8) an apparatus for generating electrical energy from an environment (Umgebungsenergie) having a first temperature region and a second temperature region comprising a thermoelectric device (Energiewandler) having a first side and a second side wherein the first side is in communication with a means for transmitting ambient thermal energy collected in the first temperature region.

2.4 Dependent claims 51-66 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, see D4.

3. Invention 3, Claims 67-85

3.1 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 67-75 does not involve an inventive step in the sense of Article 33(3) PCT.

INDEPENDENT CLAIM 67

The document D5 discloses (the references in parentheses applying to this document, cf. Figs 5 and 6):

A thermoelectric power source comprising:

a thermoelectric module (1) having at least one thermoelectric couple comprising a p-type thermoelement (2), an n-type thermoelement (3) positioned adjacent the p-type thermoelement, and an electrically conductive member (electrode 4,5) electrically connecting a first end of the p-type thermoelement with a second end of the n-type thermoelement;

a high-temperature heat pipe (22a) connected to a hot connection of the thermoelectric module; and

a low-temperature heat pipe (22b) connected to a cold connection of the thermoelectric module,

from which the subject matter of claim 67 differs in that the thermoelectric element is a sputter deposited thin film.

The problem to be solved may be regarded as seeking a more easily mass produced thermoelectric module.

The solution is obvious to a skilled person since it is known from Document D1 (Fig 2) or D7 (see Fig 17a) to make thermoelectric modules from sputter deposited thin film thermoelectric material.

3.2 Dependent claims 68-75 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, see D6, D1 and D7.

3.3 INDEPENDENT CLAIM 76

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 76-85 does not involve an inventive step in the sense of Article 33(3) PCT.

The document D6 discloses (the references in parentheses applying to this document):

a TE device (cf. Fig. 6) comprising:
a thin film TE module comprising multiple thin film TE p-type and n-type elements formed on a flexible substrate (37);
a reel having a first end and a second end and about which the flexible substrate is wound (implicit from diagram, fins 45 serves as core of the reel);
a low-temperature member thermally connected to the first end of the reel (heat exchanger 42); and
a high-temperature (member) connected to the second end of the reel (heat exchanger 43), wherein the low-temperature and high-temperature members transfer heat to the and from the TE module.

from which the subject matter of claim 76 differs in that the TE module is a power source, whereas in D6 power is supplied to the TE device (i.e. it is in cooling mode).

This difference is immaterial to the construction of the claimed device since a skilled person knows that if a temperature difference is established between the different heat

exchangers, a voltage will be generated by virtue of the Seebeck effect.

The same considerations apply to the device of document D5 in combination with D1 or D8

3.4 Dependent claims 77-85 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step.

For claims 77-79, 81 refer to document D5. For claims 80-85 refer to D6.

Re Item VI

Certain documents cited

Certain published documents

Application No Patent No	Publication date (day/month/year)	Filing date (day/month/year)	Priority date (valid claim) (day/month/year)
WO2004/105143	02.12.2004	13.05.2004	19.05.2003

Re Item VIII

Certain observations on the international application

The application does not meet the requirements of Article 6 PCT, because claims 2, 3, 28 and 29 are not clear.

Claims 2, 3, 28 and 29: The term "L/A ratios" is not defined with respect to any other parameters in the claim, rendering them unclear. However this term has been interpreted using the description for the purposes of this report.

Although claims 1 and 23 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter (thermoelectric power source) and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and/or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.